

CALIFORNIA SEA GRANT



Program Directory 2002-2003



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Sea Grant is a unique partnership of public
and private sectors, combining
research, education,
and outreach for public service.
It is a national network of universities meeting
changing environmental and economic needs
of people in our coastal, ocean,
and Great Lakes regions.

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Message from the Director...

In the preface to the 2001–2002 directory, I provided thoughts on the challenges and opportunities for California Sea Grant as I began my new job as its director. Looking forward at that time, I could not envision the extent of challenges and opportunities with which many of us would be presented in subsequent months. Now, more than ever, a key part of life in California is our collective understanding of the value of the marine environment and its resources.

The events of this past year throughout the state, nation, and world have given us pause to reflect on the conduct of our daily lives. As coastal residents, we must now add issues such as security, environmental protection, and safety to the previous challenges facing us as good stewards of the coastal environment. The desire to make informed decisions about each of these topics, inspires us to learn more about our environment.

Accordingly, I believe the relevance for a program such as California Sea Grant continues to grow. In a faster-paced world filled with surprising events each day, there is, more than ever, a need by the public for credible information. This is a central tenet of the California Sea Grant mission—to support research and education on our marine environment. At the same time, if we are to have a vibrant and resilient economy and yet conduct commerce in an environmentally responsible manner, we must seek to further our knowledge and understanding of where we live and work.

The projects and activities described in this directory provide yet another major contribution by California Sea Grant to that knowledge base. I encourage you to learn about our efforts and begin or continue a dialogue with us on how to work together. In these times of challenge, I offer you the opportunity to join with California Sea Grant for an exciting future.



Russell A. Moll
Director

Contents

What is Sea Grant?	3
California Sea Grant Personnel	3
Participating Institutions 2002–2003	5
Coastal Ocean Research	6
Aquaculture Research and Development	9
Fisheries Research and Development	11
New Marine Products Research and Development	14
Ocean Engineering and Instrumentation	16
Marine Affairs	16
Rapid Response	17
Special Competitions	
Marine Biotechnology	17
Aquatic Nuisance Species	17
Oyster Disease	18
Sea Grant Technology	18
Fisheries Habitat	19
Education	20
Index of Researchers	21



What is Sea Grant?

The National Sea Grant College Program is dedicated to enhancing the understanding, conservation, and sustainable use of the nation's coastal and marine resources. It is a network of 30 university-based programs with facilities and staff in every coastal and Great Lakes state. Activities are funded principally by the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, with matching funds from the individual states, and additional support from a variety of private sources.

Today, the Sea Grant programs are focused on making the United States a world leader in marine research and the sustainable development of marine and coastal resources. Sea Grant produces and makes available a wealth of information on marine and coastal topics, from school curriculum materials to the most advanced scientific research.

California Sea Grant College Program is the largest of the 30 Sea Grant programs and draws on the talents of scientists and engineers at public and private universities throughout the state. It is administered by the University of California and is based at Scripps Institution of Oceanography in La Jolla.

Through the research it sponsors, the program contributes to the growing body of knowledge about coastal and marine resources and helps solve contemporary marine-related problems. Through its Extension and Communications components, California Sea Grant transfers information and technology developed in its research efforts to industry, government, and the public. The nine marine advisors and specialists form a direct link for two-way communication between the university, industry, and the public. California Sea Grant supports graduate education by funding trainees to work with marine scientists and engineers on a wide range of topics.

Projects are selected on the basis of competitive, peer-reviewed proposals and address a wide range of problems and opportunities. The following pages provide summaries of the new and continuing projects funded in 2002 by California Sea Grant. Further information on any of these projects is available by contacting the California Sea Grant offices or visiting the program website at <http://www-csgc.ucsd.edu>.

California Sea Grant Personnel

Administration

California Sea Grant College Program
University of California
9500 Gilman Drive
La Jolla, California 92093-0232
Phone: (858) 534-4440 Fax: (858) 534-2231

Russell A. Moll, Director
rmoll@ucsd.edu
Dolores Wesson, Deputy Director
dwesson@ucsd.edu
Roslyn Johnson, Business Manager
rmjohnson@ucsd.edu
Shauna Oh, Research & Education
shaunaoh@ucsd.edu
Georgia Ratcliffe, Programmer/Analyst
gratcliffe@ucsd.edu
Carol Bailey-Sumber, Fiscal Assistant
cbsummer@ucsd.edu

Communications

Fax: (858) 453-2948

Marsha Gear, Coordinator
mgear@ucsd.edu (858) 534-0581
Gretchen Frederick, Publications Manager
gfrederick@ucsd.edu (858) 534-4446
Joann Furse, Publishing Specialist
jfurse@ucsd.edu (858) 534-0580
Christina Johnson, Science Writer
csjohnson@ucsd.edu (858) 822-5334

Marine Specialists

Marine Fisheries

Christopher M. Dewees
Sea Grant Extension Program
Wildlife, Fish, and Conservation Biology
University of California
1 Shields Avenue
Davis, California 95616-8751
Phone: (530) 752-1497 Fax: (530) 752-4154
cmdewees@ucdavis.edu

Seafood Technology

Robert J. Price
Food Science and Technology
University of California
1 Shields Avenue
Davis, California 95616-8598
Phone: (530) 752-2194 Fax: (530) 752-4759
rjprice@ucdavis.edu

Marine Advisors

Curry (OR) & Del Norte (CA) Counties

James B. Waldvogel
Sea Grant Extension Program
586 G Street
Crescent City, California 95531-3735
Phone: (707) 464-4711 Fax: (707) 464-7520
cedelnorte@ucdavis.edu

Humboldt & Mendocino Counties

Susan McBride
Sea Grant Extension Program
2 Commercial Street, Suite 4
Eureka, California 95501
Phone: (707) 443-8369 Fax: (707) 445-3901
scmcbride@ucdavis.edu

Sonoma & Marin Counties

Paul Olin
Sea Grant Interim Associate Director for Extension
Sea Grant Extension Program
2604 Ventura Avenue, Room 100
Santa Rosa, California 95403
Phone: (707) 565-2621 Fax: (707) 565-2623
pgolin@ucdavis.edu

San Francisco Bay Counties

Jodi Cassell
Sea Grant Extension Program
300 Piedmont Avenue
Bldg. B, Room 227
San Bruno, California 94066
Phone: (650) 871-7559 Fax: (650) 871-7399
jlcassell@ucdavis.edu

Santa Cruz & Monterey Counties

Richard M. Starr
Sea Grant Extension Program
Moss Landing Marine Laboratory
P.O. Box 440
Moss Landing, California 95039-0450
Phone: (831) 632-4442 Fax: (831) 632-4441
starr@mlml.calstate.edu

San Luis Obispo & Santa Barbara Counties

Deborah McArdle
Sea Grant Extension Program
305 Camino del Remedio
Santa Barbara, California 93110
Phone: (805) 692-1730 Fax: (805) 692-1731
damcardle@ucdavis.edu

San Diego County

Leigh Taylor Johnson
Sea Grant Extension Program
5555 Overland Avenue, Bldg. 4
San Diego, California 92123
Phone: (858) 694-2852 Fax: (858) 694-2849
ltjohnson@ucdavis.edu



Participating Institutions 2002–2003

BML	Bodega Marine Laboratory Bodega Bay, California 94923	UCSB	University of California, Santa Barbara Santa Barbara, California 93106
CSGEP	California Sea Grant Extension Program	UCSD	University of California, San Diego La Jolla, California 92093
CSULB	California State University Long Beach, California 90840	UCSF	University of California, San Francisco San Francisco, California 94143
CSUMB	California State University, Monterey Bay Seaside, California 93933	UC-SG	University of California Sea Grant College La Jolla, California 92093-0232
HMS	Hopkins Marine Station Pacific Grove, California 93950	UW	University of Washington Seattle, Washington 98195
HSU	Humboldt State University Arcata, California 95521		
MBARI	Monterey Bay Aquarium Research Institute Moss Landing, California 95039-9644		
MLML	Moss Landing Marine Laboratories Moss Landing, California 95039		
NMFS	National Marine Fisheries Service Silver Spring, Maryland 20910		
SDSU	San Diego State University San Diego, California 92182		
SIO	Scripps Institution of Oceanography La Jolla, California 92093		
SJSU	San Jose State University San Jose, California 95192		
SU	Stanford University Palo Alto, California 94305		
TSRI	The Scripps Research Institute La Jolla, California 92037		
UCB	University of California, Berkeley Berkeley, California 94720		
UCD	University of California, Davis Davis, California 95616		
UCLA	University of California, Los Angeles Los Angeles, California 90095		



Coastal Ocean Research

- **Alongshore Coherence of Nearshore Temperature Variability**

R/CZ-164 Mar. 00–Feb. 03
J.L. Largier/UCSD, SIO

As seen during recent El Niño events, ocean water temperatures have a dramatic influence on the distribution of marine life and the productivity of the sea. Spatial and temporal patterns of ocean water temperatures also provide clues to the movement of water and the dispersion of plankton, nutrients, pollution and other waterborne materials. In this project, the researcher is collating and analyzing existing data on ocean water temperatures along the state's coastline, with the goal of determining patterns in temperature variability. Special attention will be given to the spatial uniformity of changes in water temperatures at varying time scales. The researcher will also examine potential causes of temperature variability and its effects on ecosystems. This study has relevance not only to the contemporary discussion of environmental change but also to the management of marine resources.

- **Surfzone Drifters: A New Tool for Observing Nearshore Circulation**

R/CZ-166 Mar. 00–Feb. 03
R.T. Guza/UCSD, SIO

Coastal tourism represents the most valuable component of all ocean-related industries in the state. Loss of beach sand, shoreline erosion, and water pollution threaten this industry—and quality of life for the state's residents. Despite our shoreline's tremendous economic and recreational value, computational and theoretical models of beach dynamics are relatively primitive. This is largely because of the fundamental complexity underlying the interactions among waves, currents, sediments, and the sea floor. In the surf zone, ocean circulation patterns are especially complex: currents are strong and highly variable. Changes in the orientation of the coastline, headlands, submarine canyons, jetties, piers, and seawalls all add to the challenges of modeling surf-zone dynamics. This project will develop and test drifters, designed specifically to survive the rigors of breaking waves. These drifters would make it possible for oceanographers to track the paths of water parcels in the surf zone. This, in turn, will help them gain further understanding of the physics of the nearshore.

- **Observation of Physical Fluxes Between an Estuary and the Ocean**

R/CZ-170 Mar. 01–Feb. 04
M.T. Stacey, T.M. Powell/UCB

An estuarine ecosystem is strongly driven by two boundary conditions: freshwater from the river systems upstream, and fluxes from the open ocean. In San Francisco Bay the ecological role of the relationship between the coastal ocean with the Bay is largely unknown, but considered important. Achieving an understanding of the role the ocean plays in the estuarine ecosystem, and how that role varies seasonally and tidally is the goal of this project. The salinity of the estuary and the concentration of contaminants in the estuary are strongly linked to the level of exchange with the coastal ocean. Although some initial exploration into these processes has been undertaken, the researchers propose to examine in more detail how the exchange between the estuary and the ocean varies on the tidal, spring-neap, and seasonal influences.

- **Modeling of Water and Sediment Quality in Impacted Coastal Embayments**

R/CZ-171 Mar. 01–Feb. 04
K.D. Stolzenbach, J.C. McWilliams/UCLA

Coastal waters receive a variety of materials related to human activities along the shoreline. These materials come from sewage, industrial, and nonpoint sources from urban and agricultural watersheds. The effect of such influences is particularly concentrated in highly developed coastal embayments—characterized by irregular shorelines, relatively shallow water depths, and weak exchange of water with the open ocean. Human input can be relatively slow to disperse and consequently is associated with increased plankton growth and accumulation of contaminants in deposited sediments. Although coastal embayments with this problem have often been studied, a need exists for models capable of forecasting water and sediment quality for use by environmental managers.

- **Exploring the 1990s: Investigation Into Factors Controlling Siliceous Microplankton Distribution in the Santa Barbara Channel**

R/CZ-172 Oct. 01–Feb. 03
C.B. Lange, E.L. Venrick/UCSD, SIO

Radiolarians and diatoms are siliceous microfauna and flora whose distribution is controlled by circulation

and upwelling. As a result, they have proved valuable in monitoring seasonal marine variability and circulation. Unfortunately, their responses to subseasonal variations in circulation are not well understood—in part because of lack of datasets with sufficient temporal resolution. The researchers will be working with detailed oceanographic observations from buoys, drifters, and meteorological and pollution stations to evaluate surface circulation in the Santa Barbara Channel over a ten-year period. In addition, variations in radiolarian and diatom production will be determined from sediment trap samples. From these studies, they not only hope to improve understanding of biological responses to physical changes and nutrient supply within the channel, but to provide a model that can be applied in other coastal regions.

- **Recovery of Trophic Function in a Restored Pacific Coastal Wetland**

R/CZ-173 Mar. 01–Feb. 03
L.A. Levin, C. Currin/UCSD, SIO/NMFS

Loss of habitat in the coastal salt marsh is a widespread problem in Southern California and continues in the face of conservation efforts. Marsh restoration and creation have become standard mitigation measures to compensate for such losses in California and elsewhere, despite some uncertainty about their success. A major component of California salt marshes is trophic support (food web architecture, interaction strengths, and complexity) for shellfish, fish, and birds, but this has received little attention in restored wetlands. There is general recognition that to be effective, marsh restoration must achieve recovery of key ecosystem functions (productivity, decomposition, food chain support) in addition to structural attributes—natural species abundance and composition. This research will employ natural abundance- and tracer-level stable isotopic analyses to focus on the factors that promote development of food webs in natural and created marshes, an understanding that is urgently needed for wetland management.

- **Ecological Impacts of Beach Grooming on Exposed Sandy Beaches**

R/CZ-174 Mar. 01–Feb. 03
J.E. Dugan, et al./UCSB

The researchers will identify and test hypotheses concerning the impacts of beach grooming on the

structure and function of sandy beach ecosystems in Southern California. Grooming to remove macrophyte wrack and other debris is a widespread and institutionalized practice on heavily used beaches throughout the world. However, despite the prevalence and importance of beaches as coastal resources for both humans and wildlife, little information exists on the effects of this practice. Providing new information on the effects of grooming will give managers the tools needed to improve management, and develop informed and ecologically sound policies for sandy beaches.

- **Fate and Transport of Planar and Mono-Ortho Polychlorinated Biphenyls and Polychlorinated Naphthalenes in Southern California Sediments**

R/CZ-175 Mar. 01–Feb. 03
M.I. Venkatesan/UCLA

Coastal sediments in Southern California receive contributions of organic pollutants from a variety of sources such as sewage outfalls, storm runoff, dredge disposal, industrial wastes, etc. Historical studies of sedimentary chemistry have resulted in stringent laws as well as improved technologies that curtail waste disposal of toxic chemical contaminants into ocean waters. Polychlorinated biphenyls (PCBs) are industrial pollutants whose residues are found in many parts of the global ecosystem, including marine sediments. “Planar” or “nonortho” PCB congeners are present in lower concentrations than other PCB congeners, yet they can account for a significant part of the toxicity in environmental samples. The researcher will investigate more comprehensively the historic distribution and fate of these toxic compounds in the Southern California Bight sediments to assess the contaminant status of the coastal ecosystem.

- **Dynamics and Ecosystem Threats of Bidirectional Cordgrass Hybridization in San Francisco Bay**

R/CZ-178 Mar. 01–Feb. 04
D.R. Strong/UCD

Hybrids between alien cordgrass, *Spartina alterniflora*, (introduced in the 1970s) and the native California cordgrass, *S. foliosa*, are a menace to the ecology of San Francisco Bay. They are spreading widely and in aggressive fashion, invading open mud areas, displacing native species and threatening their extinction, hindering flood control, navigation, and

other habitat uses. Determining the key ecological element of this hybrid invasion is the project goal and is important to a broad range of stakeholders. Proposed strategies to restore baylands are currently being undermined by these invasions of hybrid cordgrass.

- **The San Diego–La Jolla Ecological Reserve: Implications for the Design and Management of Marine Reserves**

R/CZ-177 Mar. 01–Feb. 04
P.K. Dayton, E. Sala/UCSD, SIO

While marine reserves are popular in principle, the underlying mechanics involved in making them work are poorly understood. The researchers propose to use a small, well-protected intertidal and subtidal reserve (the San Diego–La Jolla Ecological Reserve) for their study, with the goal of defining the microhabitat components of sources, mortality, and survivability for key species in kelp forest communities. In addition, the advantages of protection and enhancement of populations in the reserve will be quantified, as there are little data of this kind in existence at the present time. This type of information is essential for resource managers in the selection and evaluation of reserves.

- **Bacterial and Protozoal Contamination of Nearshore Marine Environments in California, With Ecologically Sustainable Management Recommendations**

R/CZ-180 Mar. 02–Feb. 05
E. Atwill, P.A. Conrad/UCD

Pathogenic microorganisms enter the marine ecosystem from agricultural runoff and human sewage outflows. However, in the marine environment there are very few reported studies to monitor the levels and sources of zoonotic pathogen contamination (communicable from animals to humans). The goal of this research is to assess the current levels of zoonotic and anthropogenic protozoal marine contamination along the central coast of California. A further goal is to evaluate sustainable management recommendations that will help minimize future pollution into the nearshore marine ecosystems. Researchers will first identify critical sources of microbial contamination, develop practical and adoptable beneficial management practices for mitigating these microbial risks, and measure the efficacy of vegetative buffer strips in combination with these practices. Evaluating the health

of the nearshore marine environment will be critical in reducing the amount of fecal pathogens in storm runoffs and in minimizing their potential impact on the environment and public health.

- **Climatological and Near-Real-Time Satellite-Observed Ocean Fronts Along the California Coast**

R/CZ-181 Mar. 02–Feb. 05
W. Broenkow, et al./SJSU/MLML

Ocean fronts represent regions of convergent flow where water masses with different physical, chemical, biological, and optical properties meet. Such regions are characterized by strong gradients with concentrations of the entire food chain. Consequently, much of the commercial and recreational fishing activity off California occurs at or near these frontal areas of enhanced biological productivity. In addition to concentrating marine biota, these boundaries are sites where various pollutants also tend to accumulate and where uptake of pollutants into the food chain could occur at a higher rate. The primary goal of this research is to provide information on the spatial distribution and seasonal migration patterns of major frontal boundaries off the California coast. Infrared satellite coverage from GOES-10 and ocean color from SeaWiFS and MODIS will be used. The expected locations of these features could be of considerable importance for environmental monitoring, search-and-rescue missions, fisheries management, and adaptive sampling strategies for ongoing measurement programs such as CalCOFI.

- **Nitromusk Compounds: Are They Bio-Available and Do they Compromise Toxin Defense Systems?**

R/CZ-182 Mar. 02–Feb. 05
D. Epel, R.G. Luthy/SU

An emerging class of aquatic pollutant has been identified as originating from the pharmaceutical and personal care products (PPCPs). One group of PPCPs is the synthetic musks, produced in industrial amounts and used where a scent is desirable (e.g., perfumes, detergents, fabric softeners, etc.). These synthetic musks have been found in high levels in aquatic organisms from both freshwater and marine environments. However, the data from the marine environment are sparse. Project researchers will characterize the amounts of musks in the marine environment and their effects on compromising the cellular defense mechanism against pollutants. This work will

provide evidence on the pervasiveness and accumulation of these chemicals in the marine environment and food chain. If they are indeed present, and increase with trophic level, future work could also look at direct toxic effects of the musks and their metabolites on marine biota. The results from this study will also provide new assays for evaluating the effects of low concentrations of chemicals, and insights on sediment chemistry.

- **Effects of the San Diego–La Jolla Marine Reserve on the Abundance, Diversity, and Population Structure of Reef Fishes**

R/CZ-183 Mar. 02–Feb. 05
P. Hastings, P.K. Dayton/UCSD, SIO

Marine reserves such as the San Diego-La Jolla Ecological Reserve (SDLJER) are gaining popularity as primary tools to protect spawning stocks, biodiversity, and heritage sites. However, the impact of relatively small no-take reserves on reef-fish communities remains poorly understood. The reason for this is, in part, because of the lack of long-term comparative data, along with the probable differences in response of various component species in any local system. This research project will provide a detailed inventory of fish species recorded in the La Jolla area, and the first quantitative data on fish communities in the SDLJER. In addition, baseline data will be collected for evaluation of long-term trends in fishes inside and outside of the reserve that can be compared with similar data for other regions in California. Baselines are critical for evaluation of long-term effects, especially in the face of larger scale environmental variability such as El Niño events and global warming. The results from the study will provide needed data on fish populations from the southernmost reserves in California—essential in evaluating the role of the state’s network of marine reserves.



Aquaculture Research and Development

- **Tools for Management of Withering Syndrome in Abalone, *Haliotis* spp.: PCR Detection and Feed-Based Therapeutic Treatment**

R/A-115 Mar. 00–Feb. 03
C.S. Friedman/UW

“Withering” syndrome in abalone is a bacterial infection that causes a severe, and lethal, atrophy of the mollusk’s muscular foot. The disease has decimated abalone beds in Central California and threatens the continued expansion of abalone aquaculture in the state. This project will explore the molecular techniques needed to detect the withering syndrome bacteria in infected abalone, and a treatment for the disease. The research goal is to develop antibiotic therapies that can be added to abalone feed.

- **Development of a Recirculation System and Diet for the Culture of California Halibut (*Paralichthys californicus*)**

R/A-116 Mar. 01–Feb. 04
R.H. Piedrahita, D.E. Conklin/UCD

The development of diets and culture techniques for California halibut, which is found along the Pacific Coast from Baja California to British Columbia, is the focus of this project. Development of culture techniques for this species would create new opportunities for the aquaculture industry and for restocking and research efforts on the West Coast, and especially in California. The aim of this project is to develop a recirculation system that takes into account the utilization of protein and other feedstuffs under various nutritional regimes for the California halibut. The information generated on the proposed recirculation system design and its operation will have application for culturing other commercially important marine species.

- **Characterizing the Role of Environmental Stressors in the Development of Withering Syndrome in Red Abalone**

R/A-117 Mar. 01–Feb. 03
R.A. Tjeerdema, et al./UCD

While withering syndrome (WS) has decimated black abalone populations throughout most of California, both wild and cultured red abalone have shown

resilience under relatively optimal environmental conditions. Surprisingly, red abalone can harbor the causative bacteria without developing clinical signs of this syndrome. The changes in seawater temperature and food availability associated with El Niño events may, however, stimulate the pathogenesis of the disease in these infected animals. This study attempts to elucidate the role that these environmental stressors play in WS development, which could be a key factor for the proper management of the disease by both private aquaculturists and state resource managers.

- **Creation of a Molluscan Cell Line**

R/A-119 Mar. 02–Feb. 05
J.C. Burns, C. Friedman/UCSD/UW

The increase of oyster and clam culture in the U.S. has led to the distribution of shellfish larvae and juveniles over broad geographic regions. Better diagnostic methods are now in need to control the risk of disseminating shellfish infectious diseases. The availability of a marine mollusc cell line will greatly enhance research and diagnosis of shellfish diseases. Despite attempts by scientists to establish a marine invertebrate cell line over several decades, there is currently no marine mollusc cell line. The researchers will attempt to create a mollusc cell line, which would facilitate studies in shellfish toxicology, cell physiology, mollusc molecular biology, and infectious diseases. The interdisciplinary team consisting of shellfish biologists and pathologists, industry shellfish experts, and molecular biologists will apply novel protocols to improve the success of achieving cell line continuity. Resource managers will benefit by having an important new tool to diagnose and prevent transfer of shellfish pathogens to new geographic regions.

- **Meiosis in Tetraploid Pacific Oysters, Their Triploid Mothers, and Diploid Grandmothers**

R/A-120 Mar. 02–Feb. 05
D. Hedgecock/UCD

Triploid oysters, which have three rather than the normal two sets of chromosomes, are important in aquaculture because of favorable commercial characteristics such as near sterility, increased survival, superior growth, and meat quality. The hatchery-based Pacific oyster industry on the U.S. West Coast adopted triploid seed technology over a decade ago, as a means of producing oysters in all seasons. Until recently, triploid oysters were produced by chemical inhibition of the normal cell divisions (meiosis), by which the mature egg is produced. Now, however, all triploid offspring can be produced by fertilizing eggs from a normal diploid female with sperm from a

tetraploid male. Tetraploid oysters can also be mated with each other to propagate tetraploid stocks. The researcher seeks to evaluate this new tetraploid technology and its potential contribution to commercial ventures and hatchery bivalve management. In particular, the researcher will follow genetic markers in a variety of experimental crosses designed to reveal how meiosis works in tetraploid males and triploid females. Results obtained in this project will shed light on the fundamental process of meiosis and the evolution of polyploidy, and will have broad application to other species of oysters and bivalves cultivated worldwide.



Fisheries Research and Development

- **Patterns of Recruitment in Red Sea Urchins: A Population Genetics Approach**

R/F-178 Mar. 01–Feb. 03
R.S. Burton/UCSD, SIO

Over the past two decades, sea urchin fisheries have rapidly developed along the coasts of Northern and Southern California. Proper management of these valuable resources requires basic information concerning patterns of recruitment that replenish harvested populations. The researcher will employ multiple micro-satellite markers to document spatial and temporal patterns of genetic differentiation in young urchins, and then use that information to infer patterns of recruitment and dispersal distances. This study will provide data of direct relevance to management decisions that could directly benefit all involved in California urchin fisheries.

- **Spatial Management of Fisheries**

R/F-179 Mar. 00–Feb. 03
J.E. Wilen, L.W. Botsford/UCD

In this project, researchers are developing a bio-economic computer model of the red sea urchin fishery in Northern California. The model depicts the Northern California urchin population in terms of 11 distinct patches, linked together by physical processes such as ocean currents and winds. The model is capable of simulating the effects of establishing marine protected areas on both the sea urchin population and the fishing industry. A prime goal is to forecast and compare the likely consequences of a wide range of regulatory actions on variables such as the urchin population, egg production, urchin landings, and the value of the urchin fishery.

- **Pelagic Fish Egg Abundance and Mortality Estimation by CUFES and Real-Time Machine Vision**

R/F-180 Mar. 00–Feb. 03
D.M. Checkley, M.M. Trivedi/UCSD, SIO

To date, biologists estimate pelagic fish egg abundance by manually inspecting water samples under a microscope. The project researchers continue their efforts to fully automate a manual fish-egg counter, known as the Continuous Underway Fish Egg Sampler (CUFES). One

objective of this project is to write computer programs capable of recognizing aspherical eggs, such as those of anchovy, sardine, mackerel, and menhaden, from video images of water samples. In particular, this project focuses on developing the ability to identify sardine eggs. Once this is accomplished, sardine egg data will be used to estimate egg mortality rates, an important statistic for computing an accurate estimate of the biomass of sardines off California's coast and the distribution of its spawning stock. Fisheries managers in California and Spain have expressed an interest in the project's results.

- **Radiometric Age Validation and Demographic Analysis of Commercially Important, Long-Lived Rockfishes**

R/F-182 Mar. 01–Feb. 03
G.M. Cailliet, K.H. Coale/SJSU/MLML

Rockfishes (*Sebastes* spp.) support one of the most economically important fisheries in the Northeastern Pacific Ocean. For management strategies to play a significant role in sustaining these deep-water fisheries, they must rely heavily on life-history information such as growth rates, age structure, and longevity. The researchers will build upon a radiometric age determination technique that was successfully developed in a previous project for the bocaccio rockfish (*S. paucispinis*). This improved technique has now been applied to validate the age structure and longevity of the yelloweye (*S. ruberrimus*), blackbill (*S. melanostomus*), and canary (*S. pinniger*) rockfishes, and will provide the basis for ageing other fish species.

- **Assessment of the Reproductive Potential of Nearshore Rockfish and the Impact of Environmental Conditions**

R/F-183 Mar. 01–Feb. 04
P.M. Collins/UCSB

The objectives outlined in the state Marine Life Management Act of 1998 (Keeley Bill) will be addressed. This legislation recognized the need to regulate nearshore fisheries stocks while acknowledging that information on targeted species and their habitats was often incomplete. A series of longitudinal and cross-sectional studies of ovaries will be conducted to establish the normal course of embryonic development in grass rockfish (*Sebastes rastrelliger*) and to identify and quantify periods of oocyte and embryonic attrition. By reference to this data, the effect of individual environmental factors (food availability,

temperature variations, and pollutants) on reproductive output will be determined in grass rockfish and other species of nearshore rockfish. Agencies charged with the development of effective fisheries management plans will benefit from understanding the reproduction of live-bearing nearshore rockfish species.

- **Quantifying and Minimizing Risk That Hatchery-Enhancement Will Reduce Genetic Diversity of White Seabass**

R/F-184 Mar. 01–Feb. 04
D. Hedgecock/UCD

This research will document for the first time, the genetic risk of large-scale hatchery-enhancement of marine fisheries. Hatchery enhancement of highly fecund marine fishes may reduce genetic diversity of a fishery by swamping it with the offspring of a relatively small number of parents. In California, a large enhancement program for white seabass was started in 1994 under a memorandum of agreement between the California Department of Fish and Game, California Coastal Commission, Ocean Resources Enhancement and Hatchery Program, and Southern California Edison. The genetic risk of this program is unknown but depends on the sizes of natural and hatchery stocks and on the proportion of wild fish that are of hatchery-origin. The main objectives of this research are to provide and validate a predictive model for evaluating the impact of hatchery operations on the genetic diversity of natural populations, and to identify practical hatchery protocols for monitoring genetic impacts and minimizing risks to biodiversity.

- **Migratory Movements of Pacific Bluefin Tuna Off California**

R/F-185 Mar. 01–Feb. 03
B.A. Block, C. Farwell/SU/MBARI

This research seeks to examine movements of Pacific bluefin tuna within the California exclusive economic zone (EEZ). The goal is to determine the migratory patterns, residency time, behavior, and environmental preferences of the species while in the Eastern Pacific. Over a period of two seasons, the researchers will generate fundamental knowledge of how bluefin tuna populations are structured temporally and spatially in relation to oceanographic conditions. Not only will this study increase their baseline of knowledge about this economically important tuna species, but the data received will provide a framework for future management of Pacific bluefin tuna in the EEZs of the United States and Mexico.

- **Assessing the Impacts of Climate Change on the California Squid Fishery: An Integrated Ecosystem Approach**

R/F-186 Mar. 01–Feb. 03
B.B. Marinovic, et al./UCSC

Changes in coastal ecosystems resulting from global climate variations may be on the increase in the years ahead and the upwelling regions along the California coast are considered particularly sensitive to these changes. The project objectives will be to establish the nature and magnitude of the relationship between physical oceanographic and food web dynamics, and to model the socioeconomic consequences of predicted climate changes. Market squid (*Loligo opalescens*), the most valuable single species commercial fishery in California, is an ideal selection for such a model as it matures, spawns, and dies in one year. Thus, it is thought that a strong link may exist between climatic variability and squid production.

- **California's Dungeness Crab: Conserving the Resource and Increasing the Net Economic Value of the Fishery**

R/F-187 Mar. 01–Feb. 04
D.G. Hankin, et al./HSU/UCD

In the Pacific Northwest (CA/OR/WA), the historical mainstays of the fishing industry have been the Pacific salmon, groundfish, and Dungeness crab fisheries. However, recent cuts in allowable landings of salmon and groundfish have shifted fishing effort toward crab. Diminished fishing opportunities in salmon and groundfish in California will further increase fishing effort on Dungeness crabs, resulting in the fishing density that now characterizes the fishery, and imposing increased pressure on stocks at deeper depths. Projected increased fishing effort will also likely create new biological conservation concerns for Dungeness crab populations, and diminish its net economic value. In this project, researchers will produce biological information critical for the management of this increasingly intense fishery. They will also develop and explore the potential performance of alternative management regimes that could increase the fishery's net economic value and safety.

- **Fisheries Habitat: Recruitment, Growth, and Survival of Coastal Fishes on an Experimental Artificial Reef**

R/F-188 Mar. 01–Feb. 03
T. Anderson/SDSU

Previous studies of artificial reefs and their contribution to fish production have been the target of criticism for various reasons. A unique large-scale experimental reef system deployed in Southern California waters addresses many of the concerns raised. Recruitment, growth, and survival of economically important and other nearshore fishes will be compared among replicated treatments of habitat structure.

- **Conservation Genetics of California Abalone: Developing Tools for Management**

R/F-189 Mar. 02–Feb. 04
R.S. Burton/UCSD, SIO

Abalone populations have suffered enormous declines in Southern California waters over the past few decades, so much so that one species now faces the threat of extinction. Several planned and ongoing projects seek to preserve and restore abalone populations, including plans to outplant hatchery-reared abalone or translocate broodstock to reestablish or enhance local breeding populations. Population genetic data can contribute to successful implementation and evaluation of these programs by allowing an assessment of the extent of interpopulation recruitment and gene flow among natural populations, and estimation of the effective sizes of both natural and hatchery populations. The researcher will apply multiple genetic methodologies to samples of abalone populations. The goal is to elucidate recruitment patterns and thereby provide information to aid in the effective management and conservation of abalone species in California. Monitoring genetic diversity within hatchery populations will help minimize genetic impacts of outplanting on natural populations and also aid in evaluating the success of abalone outplanting programs.

- **Bomb Carbon in the Yelloweye Rockfish, *Sebastes ruberrimus*, as a Chronological Benchmark for Age Validation of Commercially Important Fishes**

R/F-190 Mar. 02–Feb. 04
G.M. Cailliet, et al./SJSU/MLML

Errors in age determination in fish can lead to errors in their management. It is essential to validate the age estimation procedures and longevity for commercially important rockfish because proper management

strategies rely heavily on growth rates, age structure, and longevity estimation. The researchers plan to use the time-specific bomb carbon signal recorded in the otoliths (ear bones) of fish, and build upon their prior radiometric age determination work to establish a basis for validating the age and growth of rockfish. In addition, this work will establish a chronological benchmark for the Northeastern Pacific Ocean, providing a foundation for future age validation in this region. The overall aim of this project is the determination of bomb carbon in the age-validated yelloweye rockfish (*Sebastes ruberrimus*) as a chronometer for validating the age and growth of at least two other commercially important species: dusky (*S. ciliatus*) and cowcod (*S. levis*) rockfish. There is a critical and timely need for this information with the increased utilization of rockfishes in the Northeastern Pacific Ocean, many of which are long-lived and have slow population turnover rates.

- **Pattern and Association in Pelagic Zooplankton and Fish and Their Use in Resource Assessment**

R/F-191 Mar. 02–Feb. 05
D.M. Checkley, J.R. Hunter/UCSD, SIO

Wise management of small, pelagic fish like sardine, anchovy, and mackerel, should be based on an understanding of their population dynamics. Variation in the size of populations and spawning habitat of these species are likely related to variation in their environment. The distribution and abundance of the zooplanktonic food available to larvae, juvenile, and adult fish are important characteristics of their pelagic environment. This project seeks to explain variation in their spawning habitat with the knowledge of distribution and abundance of the zooplankton. The results of this study will increase understanding of these fish and the fluctuations in their spawning stock size and location, with implications for basic science, management, and policy.

- **Catch and Release of California Sheephead: Physiological and Behavioral Stress Effects and Post-Release Survivorship**

R/F-192 Mar. 02–Feb. 04
C. Lowe, K.M. Kelley/CSULB

The California sheephead comprises the largest component of the commercial live-fish fishery in Southern California and is a highly sought and prized sport fish. Declines in commercial and sport catch rates of the species have resulted in state regulations requiring the release of sheephead less than 12 inches.

The need to understand the impacts of catch-and-release practices on the post-release biology of this fish is therefore critical in determining whether this management strategy will be effective. However, the stress impacts of catch-and-release practices are not known for sheephead. Researchers will determine the degree to which fishing technique and angling/trap duration induce stress in sheephead, as well as the degree to which this stress impacts anabolic function and subsequent survivability in these fish. Results obtained in this study will provide fisheries managers with the critical data needed to improve management strategies for sheephead, a key species in the developing Nearshore Fisheries Management Plan.



New Marine Products Research and Development

- **The Biomedical Potential of California Marine Organisms**

R/MP-87

Mar. 00–Feb. 03

D.J. Faulkner/UCSD, SIO

The literature of marine natural products reveals that most studies of metabolites from California's marine organisms were performed during the 1970s. Few compounds were systematically evaluated for their biological or pharmacological activity, but rather for the novelty of the structures. Furthermore, the main focus of marine organism collections was on tropical environments, that provided greater biodiversity, than on California waters. This project plans to revisit California waters and to screen extracts of marine organisms found there in bioassays far superior to those used in earlier investigations. In addition, the researcher seeks to provide data that will help in the assessment of the potential value of California's marine invertebrates and algae.

- **Investigation of Anti-Cancer Compounds in the Marine Bryozoan, *Bugula pacifica***

R/MP-88

Mar. 01–Feb. 03

M. Haygood/UCSD, SIO

The marine bryozoan *Bugula pacifica* has never been investigated for bioactive metabolites. It is a close relative of *Bugula neritina*, the source of the bryostatins—a family of macrolides that are in clinical trials for treatment of cancer. Both *B. pacifica* and *B. neritina* have unusual bacterial symbionts. In previous studies by this researcher, it was shown that the symbiont of *B. neritina* is the likely biosynthetic source of the bryostatins. The researcher hypothesizes that *B. pacifica* contains compounds related to, but distinct from, the bryostatins. This project will test this hypothesis through a combination of approaches: natural products chemistry, microbiology, and molecular biology. The results may be new drug candidates and biosynthetic genes that can be used to develop an economical and environmentally sound method of production.

- **Marine Natural Materials: Novel Biological Elastomers from Marine Invertebrates**

R/MP-91 Mar. 01–Feb. 04
R.E. Shadwick, H. Waite/UCSD, SIO/UCSB

The diverse marine life in coastal California offers great opportunity for discovery of such materials and new insights for their design based on biological models. By combining techniques of materials science and protein chemistry, the researchers propose to develop a program to characterize structural protein polymers—(principally elastomers) that have unusual mechanical properties. The focus will be on a detailed molecular and mechanical description of novel biopolymers, comprising egg capsules of marine snails. The application potential of this project is mainly in areas related to human tissue engineering or construction of novel engineering materials. For example, the energy-absorbing and self-healing properties exhibited by egg capsule material are desirable features for medical implants such as the repair of ligaments and tendons. These studies may also help in the design of strategies for encapsulating pharmaceutical agents for use in targeted drug delivery, one of the most challenging problems in today's pharmaceutical industry.

- **New High-Performance Nanocomposite Materials from Marine Biomineralization: Biotechnological and Interdisciplinary Approach**

R/MP-92 Mar. 01–Feb. 04
D.E. Morse/UCSB

There is a wide and increasing range of applications for high-performance composites that may be used in advanced microelectronic, optical, and medical devices. To meet these needs, materials engineers are turning to “bio-ceramics” produced by marine organisms, as these offer a unique combination of strength, precise structural control, and biocompatibility, all of which are essential in such applications. New discoveries by the researcher, coupled with recent advances in biotechnology, sophisticated instrumentation, and the chemistry of self-assembling structures, now bring these high-performance materials and their mechanisms of action within reach. This project will involve collaboration with industrial colleagues from three world-renowned biotechnology and chemical manufacturing corporations in the development of commercially valuable silicon-based products.

- **Novel, Post-Translationally Modified Peptide Antibiotics from Solitary Tunicates (“Sea Squirts”)**

R/MP-93 Mar. 01–Feb. 04
R.I. Lehrer, et al./UCLA/UCSD, SIO

Resistance to antibiotics is an ever-increasing problem, in part resulting from their overuse in animal husbandry and medical practice. Alternative strategies to fight infection are a high priority. The immune systems of invertebrates have recently been shown to contain various molecules with antibiotic properties, including gene-encoded antimicrobial peptides. This research will center on sea squirts—simple marine invertebrates that are believed to be ancestral to vertebrates. The study will focus on three species of tunicates (*Styela clava*, *S. plicata*, and *Ciona intestinalis*) that occur in abundance at San Diego's docks and marinas. Not only do these tunicates possess potentially useful antimicrobial peptides, they have novel metabolic pathways that modify the structures of these peptides to enhance their potency.

- **Molecular Approaches in Marine Pharmacology**

R/MP-94 Mar. 02–Feb. 05
A. Butler/UCSB

Many halogenated and selectively oxidized compounds isolated from marine organisms have antineoplastic, antimicrobial, and anti-inflammatory activities. The project is designed to assess the overall feasibility of biotechnological methodologies to produce novel compounds and enzymes that are highly active and in great demand. The overall objectives are to clone, express, and study the reactivity of the halogenating enzymes from species of marine algae that produce biomedically important halogenated natural products. It further seeks to evolve the activities of the cloned haloperoxidases for enhanced application in diagnostic assays. Development of the endogenous enzyme-catalyzed processes of marine organisms for the synthesis of important marine natural products, or for the synthesis of other intermediate compounds, provides an economical, alternative source of these novel compounds. The results of this study will provide insights into the natural endogenous role of haloperoxidases in the life cycle of marine organisms.

Ocean Engineering and Instrumentation



- **Mitigation of Coastal Bluff Instability in San Diego County, California**

R/OE-37 Mar. 01–Feb. 04
S.A. Ashford/UCSD

There is a long history of bluff failures causing death and property damage in San Diego County. Moreover, there is currently no information source in San Diego County that local residents, city officials, or the California Coastal Commission can use to evaluate the effectiveness of bluff stabilization alternatives. To address the need for critical evaluation of bluff stabilization measures, this study will develop recommendations for mitigating the hazard of coastal bluff instability and for the evaluation of bluff stabilization alternatives in San Diego County. The researcher will first develop a detailed inventory of current mitigation approaches, including use of seawalls, rock anchors, and dewatering, and then conduct finite difference analyses to determine the effects of each of these measures on bluff stability. The evaluations of bluff stabilization alternatives will provide clear and up-to-date information for local and state government agencies faced with regulating land use in the vicinity of these slopes—both beach access below and residential and commercial use above. Though the study will concentrate on San Diego County, the results will be applicable to similar bluffs found along the Pacific Coast.

Marine Affairs

- **Building Marine Policy Analysis Capabilities in California**

R/MA-41 Mar. 01–Feb. 04
J.E. Wilen, L.W. Botsford/UCD

New legislation adopted under California's Marine Life Management Act signals a strong commitment to scientifically-based management policies. In order to forecast and understand the implications of management options, it will be important to add modeling, stock assessment, and the capability of policy analysis to agencies responsible for marine management. This proposal contains a short-term plan to bridge the gaps in expertise, combined with a longer-term training program designed to enhance the ranks of marine policy analysts and stock assessment modelers. Management agencies, the fishing industry, general public, and other direct-user stakeholder groups will all benefit from enhanced capacity to analyze marine policy decisions.

- **Empirical Evaluation of Regional Scale Marine Reserves and the Groundfish Trawl Fishery with Geographical Information Systems, Analysis of Covariance and Bioeconomic Modeling**

R/MA-42 Mar. 02–Feb. 05
M. Dalton, S. Ralston/CSUMB

Marine reserves will have important impacts on fishermen and coastal communities. The responses of fishermen to marine reserves will also impact overall ecosystem health. To help fisheries managers make informed decisions about marine reserves, this project will use an integrated approach that includes GIS, statistical analysis, and bioeconomic modeling of the groundfish trawl fishery. Further, it seeks to understand and predict effects of marine reserves and other policies on groundfish stocks and fishermen's behavior. This integrated approach to policy analysis will provide a multidisciplinary framework for evaluating the benefit/cost tradeoffs of marine reserves and other approaches to fisheries management, such as catch and effort controls. This multidisciplinary framework will be an important tool for marine reserve analysis and a major innovation for evaluating the benefits and costs of alternative forms of fisheries management.

Rapid Response

- **Rapid Response**

R.A. Moll/UC-SG

Because conditions in the marine sphere can change rapidly as a result of both human and natural causes, problems that need immediate attention can arise unexpectedly. The rapid response project allows prompt support for short-term marine-related research, outreach, and education projects as needs arise.

Special Competitions

Marine Biotechnology

- **Development of Molecular and Cellular Tools for the Detection of Environmental Endocrine Disruption in Aquatic Invertebrates**

R/CZ-168 Oct. 00–Sept. 02
M.J. Snyder, et al./UCD/BML/UCSF

A number of environmental contaminants are known to have direct or indirect effects on the endocrine systems of higher organisms. Toxicants of this type have been termed environmental endocrine disruptors (EDs). Some of the most widely studied examples of ED effects in wildlife are cases of sexual malformities in reptiles, reproductive abnormalities in birds, and production of female yolk protein in male fishes. Though much is known about effects of EDs in fish and amphibians, there are few examples for invertebrates. The most widely cited reports are those of masculinization (imposex) and other sex organ abnormalities in molluscs, but little information exists concerning ED-like phenomena in the aquatic and marine environments. The results of this work, to be conducted in collaboration with the U.S. Environmental Protection Agency and the California Department of Fish and Game, will be of substantial interest to environmental decisionmakers and scientists working on aquatic invertebrates.

- **Molecular and Bioassay-based Investigation of Bivalves as Transmission Vectors of Protozoal Encephalitis in Southern Sea Otters**

R/CZ-169 Jul. 01–Jun. 03
P.A. Conrad, et al./UCD/BML

Emerging infectious diseases, sometimes called “pathogen pollution,” are some of the major causes of species extinction, along with habitat loss, and alien species invasions. Protozoal encephalitis, thought to play a role in illness and mortality rises in southern sea otters, may be symptomatic of a larger environmental problem—one that may be revealed through identification of risk factors for infection. This research seeks to provide new tools (molecular and serodiagnostic tests) for studying the ecology of *Toxoplasma gondii*—a ubiquitous protozoal parasite—in the coastal marine ecosystem. The goal is to provide information on geographic and demographic risk factors for use by wildlife biologists involved in the management of southern sea otters, as well as by veterinarians caring for otters in captivity.

Aquatic Nuisance Species

- **Combating *Arundo donax* and Other Rhizomatous, Aquatic, and Estuarine Nuisance Grasses by Exploiting Their Ecophysiological Characteristics**

R/CZ-163 Oct. 99–Aug. 02
A. Wijte/CSULB

Nonindigenous species in North American ecosystems are changing native species composition and diversity. Aquatic and estuarine habitats are particularly susceptible to these invasions. The water that defines them adds logistical obstacles to large-scale eradication efforts, and it plays an important role in transport and propagation success of invading species. Expansions of three nonindigenous rhizomatous grasses, *Spartina alterniflora*, *Arundo donax*, and *Phragmites australis*, have occurred in waters off both Eastern and Western Coasts of the U.S. The researcher seeks to establish an alternative to the existing mechanical and chemical eradication methods presently employed, and to improve the timing of herbicide treatments by linking them to the physiology of the plants.

- **West Coast Ballast Outreach Project**

A/EA-3

Oct. 01–Sept. 03

J. Cassell/CSGEP

In 1999, California Sea Grant Extension Program initiated the West Coast Ballast Outreach Project to address ballast water management concerns. Widespread awareness of aquatic nuisance species (ANS) and ballast management issues has increased in the West Coast maritime industry over the past two years—in large part as a result of this project. In an effort to significantly reduce the risk of invasions via ballast water, the project will continue industry involvement and the use of a multi-stakeholder approach to improve knowledge and understanding of current ballast water management strategies and ANS issues. Given the already established multi-stakeholder network and partnerships with many involved organizations, the goal is to coordinate ballast water management activities in the West Coast. Further, it will bolster industry interest and participation in ballast water treatment technology, thereby enhancing the potential for adoption of appropriate strategies. The pooling of resources and promotion of coordination efforts will provide a truly inter-disciplinary mechanism for mitigating ANS problems, while supporting efforts to deal with the difficult issue of ballast water management.

- **Physiological Adaptation and Invasion Success: A Comparison of Native and Invasive Species of Bay Mussels (*Mytilus trossulus* and *M. gallo-provincialis*) in the Central California Hybrid Zone**

R/CZ-179

Oct. 01–Sept. 03

G.N. Somero/SU

Although the physical mechanisms underlying biological invasions of nonindigenous species are often clear (e.g., transport via ballast water), there is little currently known about the biological determinants of invasion success. The project goal is to study the mussels of the Pacific Coast and determine how physiological factors influence invasion success since both native and invasive mussel species overlap in distribution. By characterizing the tolerance of physiological systems of both species and their hybrids to the conditions of temperature and salinity that exist along the Pacific Coast, it may be possible to understand the basis of the invader's success. The extent of its spread into more northern waters, where temperatures are lower and salinity level variations are higher, may also be predicted. With the results from both the field and laboratory studies, the researcher will pinpoint the

physiological systems that seem most important in governing the environmental ranges of the species and their hybrids. He will then be able to identify which physiological traits may be of most general importance in determining the success of a biological invader.

Oyster Disease

- **Toward the Genetic Engineering of Disease Resistance in Oysters**

R/A-112

Oct. 99–Dec. 02

C. Friedman, J.C. Burns/UW/UCSD

Cultivation of the oyster, *Crassostrea virginica*, was once a flourishing industry in bays along the Eastern seaboard, but the fishery has been decimated by protozoal infections. This proposal offers an innovative solution through introduction of foreign genes that will protect hatchery-raised oysters against these infections. Establishing that expression of a heterologous antimicrobial peptide in oyster cells can be used to protect against infection with *Perkinsus marinus* may lead to a patentable invention that could be of economic benefit to U.S. aquaculture companies.

Sea Grant Technology

- **PCR Quantitative Assay for Marine Bacteria**

R/CZ-167

Mar. 00–Jun. 02

C. Brunk/UCLA

Monitoring of bacterial pollution currently relies on culture plate assays. These assays are restricted to bacteria that can only be readily grown under laboratory conditions and therefore cannot always provide an accurate measurement of samples from other environmental pollution sources. However, with the use of quantitative polymerase chain reaction (QPCR) assays, bacteria from specific pollution sources can be measured. The researcher will seek to determine which of two different QPCR techniques is most appropriate for detecting bacterial pollution in coastal marine waters. A major objective of this project is to establish a protocol allowing for QPCR analysis of specific bacteria that can be performed under general monitoring conditions as well as in the research laboratory.

- **Expression of Recombinant Proteins in Microalgae**

R/MP-90 Mar. 01–Aug. 02
S.P. Mayfield, S.E. Franklin/TSRI

The production of heterologous proteins in terrestrial plants such as corn and soybeans has received considerable research attention in the past several years in response to the increasing demand for economical and valuable biopharmaceuticals. This technology offers the promise of making antiviral therapies available that were previously ignored because of their prohibitive production expense. Higher plant systems used to produce protein complexes even on a small scale have the added drawback of often requiring several years from the initial transformation event to their evaluation and production. The focus of this proposal is to explore a new system for recombinant protein expression using the eukaryotic green algae *Chlamydomonas reinhardtii*. The choice of *C. reinhardtii* is based upon its possession of a number of key criteria (fast growth rate, high cell densities, large scale culture, low contamination risk, etc.) in addition to being the focus of extensive molecular genetic analysis for the past 20 years.



- **Seismic Performance of Port Facilities: Full-Scale Testing at the Port of Long Beach**

R/OE-38 Oct. 01–Sept. 02
S.A. Ashford/UCSD

The Marine Facilities Division of the California State Lands Commission, with funding through FEMA and the California Office of Emergency Services, is developing specific regulations for the seismic performance of marine oil terminals in California. The research will involve a full-scale test aimed at transferring cost-effective seismic design criteria to end-users, such as the Port of Long Beach (POLB), in addition to those of Los Angeles, Oakland, and San Diego. Using the data collected from POLB, the project seeks to verify the performance of the pier subjected to large lateral displacements in accordance with the new Seismic Criteria for California Marine Oil Terminals. A further goal is to back-calculate soil springs for silt-type foundation soils, which are widespread on the Pacific Coast. The analysis results will then be used to educate port personnel on the new Seismic Design Criteria, as well as to update the end-users on current technology for full-scale testing of port facilities.

Fisheries Habitat

- **Characterization of the California Continental Margin: Identification, Quantification, and Synthesis of Existing Information**

R/F-181 Jul. 00–Jun. 02
H.G. Greene, R. Kvitek/SJSU/MLML/CSUMB

The researchers will identify, catalogue, digitize, reinterpret, and archive existing geophysical data for the purpose of providing critical fish habitat classification maps of the California continental margin. This work will include side-scan sonar mosaics, subbottom seismic profiles, and depth measurements from industry sources not previously available to the general scientific community. Focus will be on priority areas of fish habitat selected at the strategic planning meeting of the California Marine Habitat Task Force in January 2000. Compiled datasets of these areas will be processed into marine habitat GIS themes. In areas where information from industry is lacking, the researchers will use the state-of-the-art seafloor mapping facility at California State University, Monterey Bay to acquire and process new data over the period of the project.

Education

- **Sea Grant Trainees**

E/G-2
R.A. Moll/UC-SG

Sea Grant's commitment to furthering marine-oriented education is met by the Sea Grant trainee project. Graduate students participate in research and work on problems relating to marine resources while fulfilling thesis requirements. This experience prepares them to enter positions in academia, government, and industry.

- **California Sea Grant State Fellowship Program**

E/G-9
R.A. Moll/UC-SG

The State Fellowship Program, modeled after the Dean John A. Knauss Marine Policy Fellowship, provides graduate students with training in the development and implementation of policy. Interns are assigned to a state agency, legislative committee, or office concerned with marine resource issues.

- **John D. Isaacs Memorial Sea Grant Scholarship**

E/UG-4
R.A. Moll/UC-SG

The John D. Isaacs Memorial Sea Grant Scholarship was established in 1981 to recognize excellence in research by high school students, to encourage interest in marine science at the high school level, and to encourage pursuit of scholastic excellence in higher education. Each year a California high school junior or senior, who presents an outstanding marine science project at the California State Science Fair, receives a scholarship to study at a college or university in California.

- **Assessing Sanctuary Shorelines: A Role for Volunteers, Particularly High School Students, in Resource Management**

E/UG-6
J.S. Pearse, J.B. Heffington/UCSC

This project addresses two increasingly recognized problems. While marine biota undergo changes in response to environmental conditions, monitoring

programs to document these actions are poorly developed. In addition, long-term programs are particularly difficult to establish and maintain. In order to gain an appreciation of the natural world and how it works, the general public needs more exposure to real-life experiences with nature, including the marine environment. The researcher plans a practical ongoing procedure for quantifying the abundance of selected marine species in the Monterey Bay National Marine Sanctuary with the help of high school students and local volunteers. The goal is to engage residents in rich and diverse marine habitats, thereby providing them with the hands-on experience of gathering and interpreting data on its biota.



Index of Researchers

Anderson, T. (SDSU)	13	Lange, C.B. (UCSD,SIO)	6
Andrews, A. (SJSU/MLML)	13	Largier, J.L. (UCSD,SIO)	6
Arkush, K.D.(UCD/BML)	17	Lehrer, R.I. (UCLA)	15
Ashford, S.A. (UCSD)	16,19	Levin, L.A. (UCSD,SIO)	7
Atwill, E. (UCD)	8	Lowe, C. (CSULB)	13
		Luthy, R.G. (SU)	8
Block, B.A. (SU)	12		
Botsford, L.W. (UCD)	11,16	Mangel, M. (UCSC)	12
Breaker, L. (SJSU/MLML)	8	Marinovic, B.B. (UCSC)	12
Broenkow, W. (SJSU/MLML)	8	Mavor, T. (SJSU/MLML)	8
Brunk, C. (UCLA)	18	Mayfield, S.P. (TSRI)	19
Burns, J.C. (UCSD)	10,18	McWilliams, J.C. (UCLA)	6
Burton, R.S. (UCSD,SIO)	11,13	Morse, D.E. (UCSB)	15
Butler, A. (UCSB)	15		
		Page, H.M. (UCSB)	7
Cailliet, G.M.(SJSU/MLML)	11,13	Pearse, J.S. (UCSC)	20
Cassell, J. (CSGEP)	18	Peeke, H. (UCSF)	17
Chechowitz, M.A.(UCD/BML)	17	Piedrahita, R.H. (UCD)	9
Checkley, D.M.(UCSD,SIO)	11,13	Powell, T.M. (UCB)	6
Cherr, G.N. (UCD)	17		
Coale, K.H. (SJSU/MLML)	11,13	Ralston, S. (CSUMB)	16
Collins, P.M. (UCSB)	11		
Conrad, P.A. (UCD/BML)	8,17	Sala, E. (UCSD,SIO)	8
Conklin, D.E. (UCD)	9	Shadwick, R.E. (UCSD,SIO)	15
Croll, D.A. (UCSC)	12	Snyder, M.J. (UCD/BML)	17
Curran, C. (NMFS)	7	Somero, G.N. (SU)	18
		Stacey, M.T. (UCB)	6
Dalton, M. (CSUMB)	16	Stolzenbach, K.D. (UCLA)	6
Dayton, P.K. (UCSD,SIO)	8,9	Strong, D.R. (UCD)	7
Deweese, C.M. (UCD)	12		
Dugan, J.E. (UCSB)	7	Taylor, S.W. (UCSD,SIO)	15
		Tjeerdema, R.A. (UCD)	9
Epel, D. (SU)	8	Trivedi, M.M. (UCSD,SIO)	11
Farwell, C. (MBARI)	12	Vacquier, V.D. (UCSD,SIO)	15
Faulkner, D.J. (UCSD,SIO)	14,15	Venkatesan, M.I. (UCLA)	7
Franklin, S.E. (TSRI)	19	Venrick, E.L. (UCSD,SIO)	6
Friedman, C. (UW)	9,10,18	Viant, M.R. (UCD)	9
Gardner, I.A. (UCD/BML)	17	Waite, H. (UCSB)	15
Greene, H.G. (SJSU/MLML)	19	Wenner, A.M. (UCSB)	7
Griffin, F. (UCD/BML)	17	Wijte, A. (CSULB)	17
Guza, R.T. (UCSD,SIO)	6	Wilens, J.E. (UCD)	11,16
Hackett, S.C. (HSU)	12		
Hankin, D.G. (HSU)	12		
Hastings, P. (UCSD,SIO)	9		
Haygood, M. (UCSD,SIO)	14		
Hedgecock, D. (UCD)	10,12		
Heffington, J.B. (UCSC)	20		
Hunter, J.R. (UCSD,SIO)	13		
Kelley, K.M. (CSULB)	13		
Kvitek, R. (CSUMB)	19		

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